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## Session A3 - Fish passage survival improvements measured at Positive Barrier Guidance Systems

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# **Fish Passage Survival Improvements Measured at Fish Guidance Systems**

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# **Juvenile Fish Passage Behavior**

**In general, juvenile anadromous salmonids and clupeids:**

- **Follow bulk flow in the river thalweg**
- **Are surface oriented**
- **Cue on flow and turbulence**
- **May respond to changes in water quality**

**Migratory cues are disrupted in reservoirs**

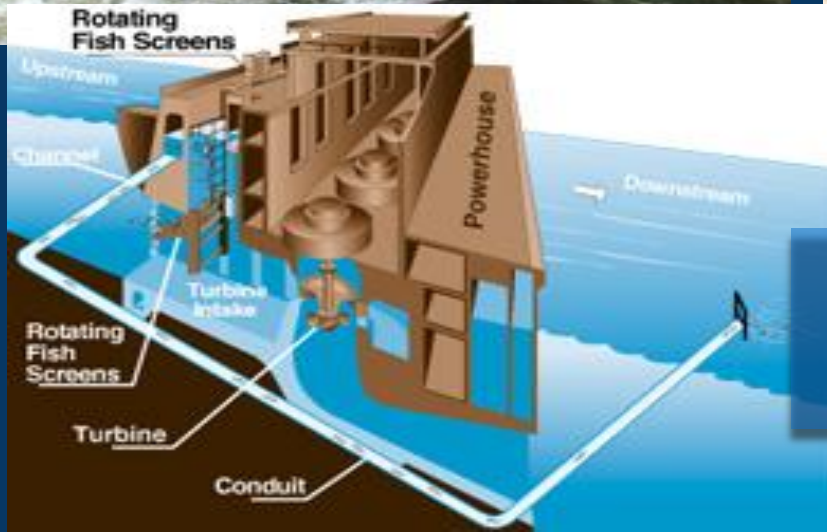
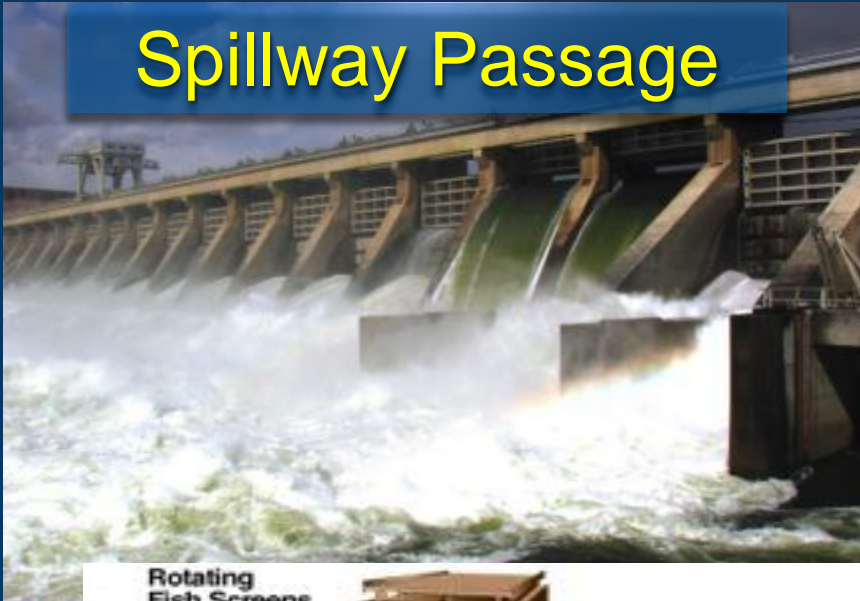
# Problem





# Juvenile Fish Bypass

## Spillway Passage



## Collection and Transport Systems

## Screened Turbine Intake and Bypass

# Non-Physical Guidance

Lights



Acoustic



Bubble Curtains





# Fish Guidance System





# Fish Guidance System

➤ Provides several cues to alter fish migration routes

- Physical
- Visual
- Hydraulic



# Little Goose Dam, Snake River, Washington State

Spillway →

Powerhouse →

Image U.S. Geological Survey

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# Forebay Hydraulics and Fish Behavior

Spillway →

Powerhouse →

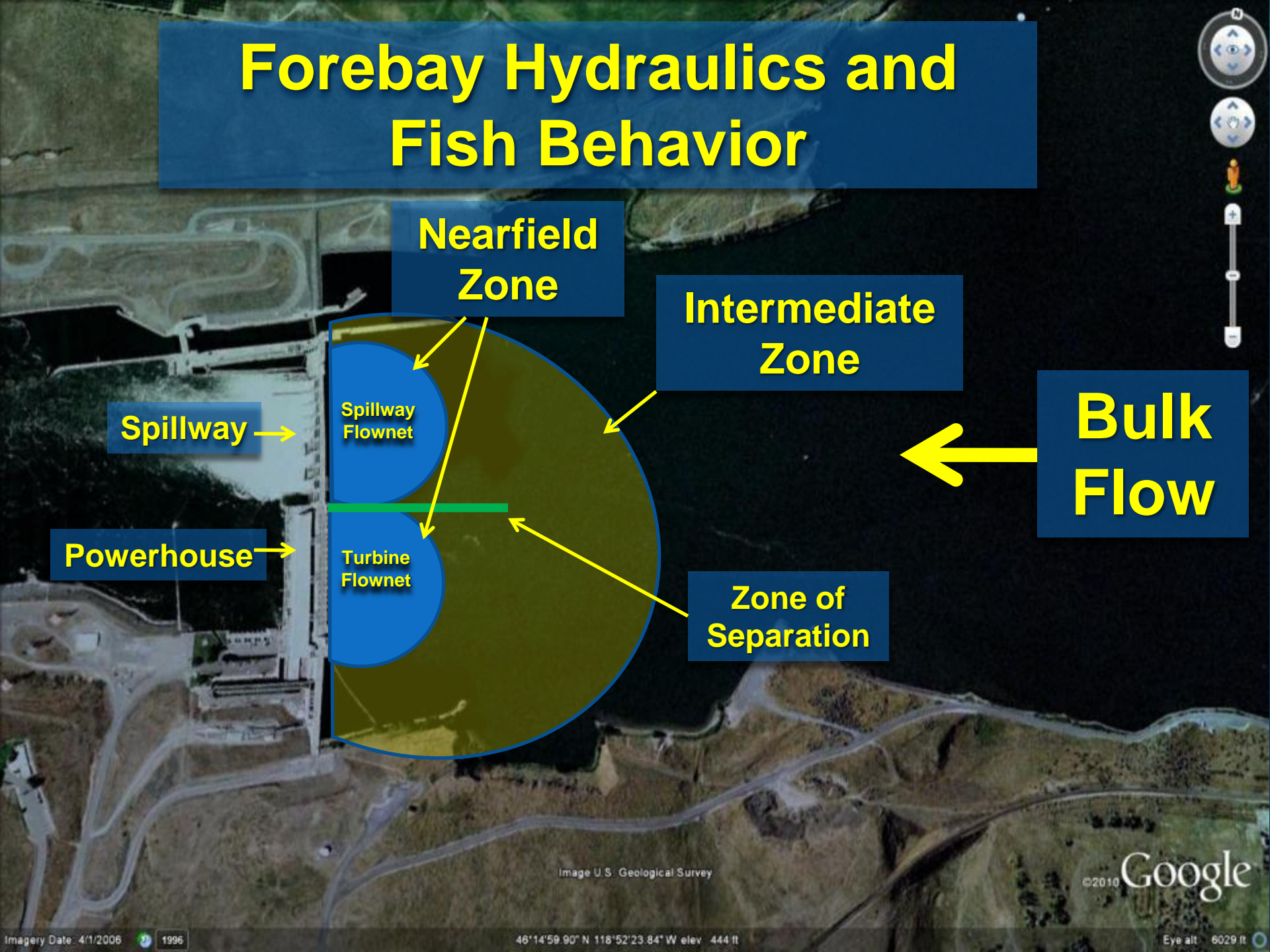
Bulk Flow ←

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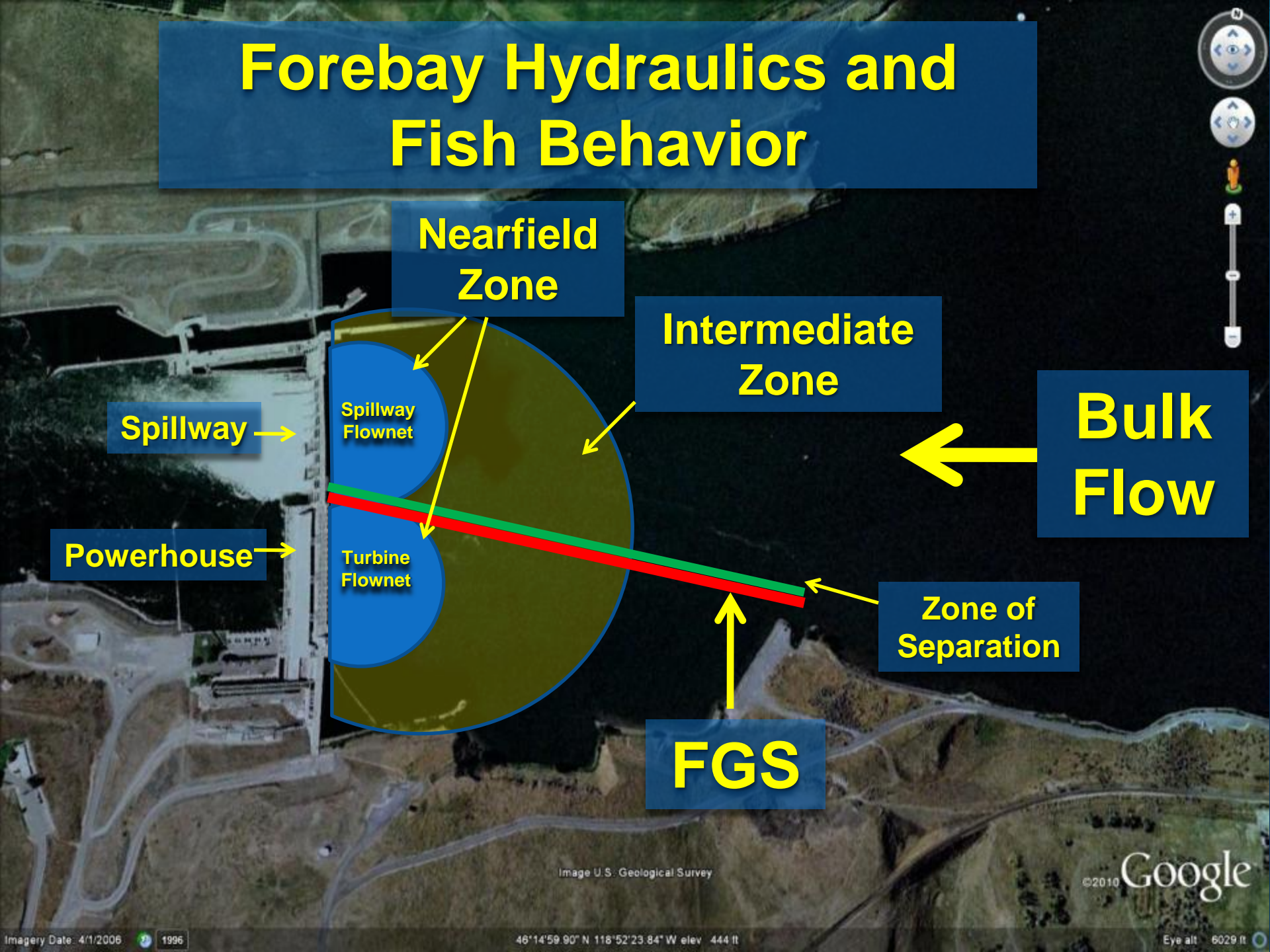


# Forebay Hydraulics and Fish Behavior





# Forebay Hydraulics and Fish Behavior





# Lower Granite Dam

## Snake River, Washington State

Prototype  
Surface Bypass  
System

Debris Boom

FGS

Image U.S. Geological Survey

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# FGS Results

- 80% fish guidance
- Reduced turbine entrainment 16%

FGS

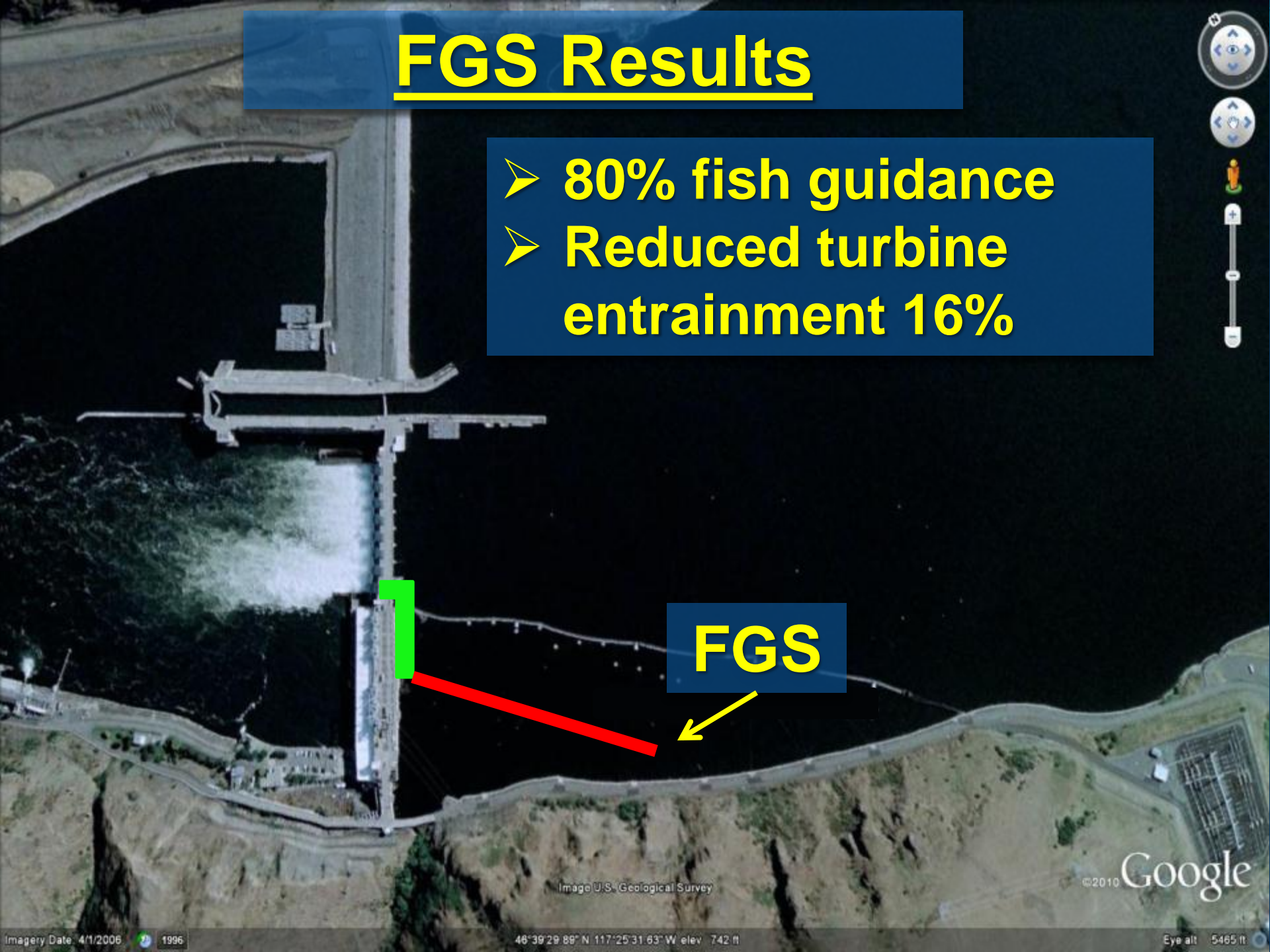


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# Bonneville Dam, Columbia River, WA



**US Army Corps  
of Engineers®**

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# Bonneville Dam, Powerhouse 2 Fish Guidance System



US Army Corps  
of Engineers

Powerhouse

Juvenile  
Bypass  
Channel

Fish  
Guidance  
System



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# FGS Results



US Army Corps  
of Engineers®

- 15% guidance improvement for juvenile spring chinook passage
- Guided fish entered the bypass at twice the rate of unguided fish

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# Cowlitz Falls Dam, Cowlitz River, WA



Surface  
Collector

FGS



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Image © 2011 GeoEye



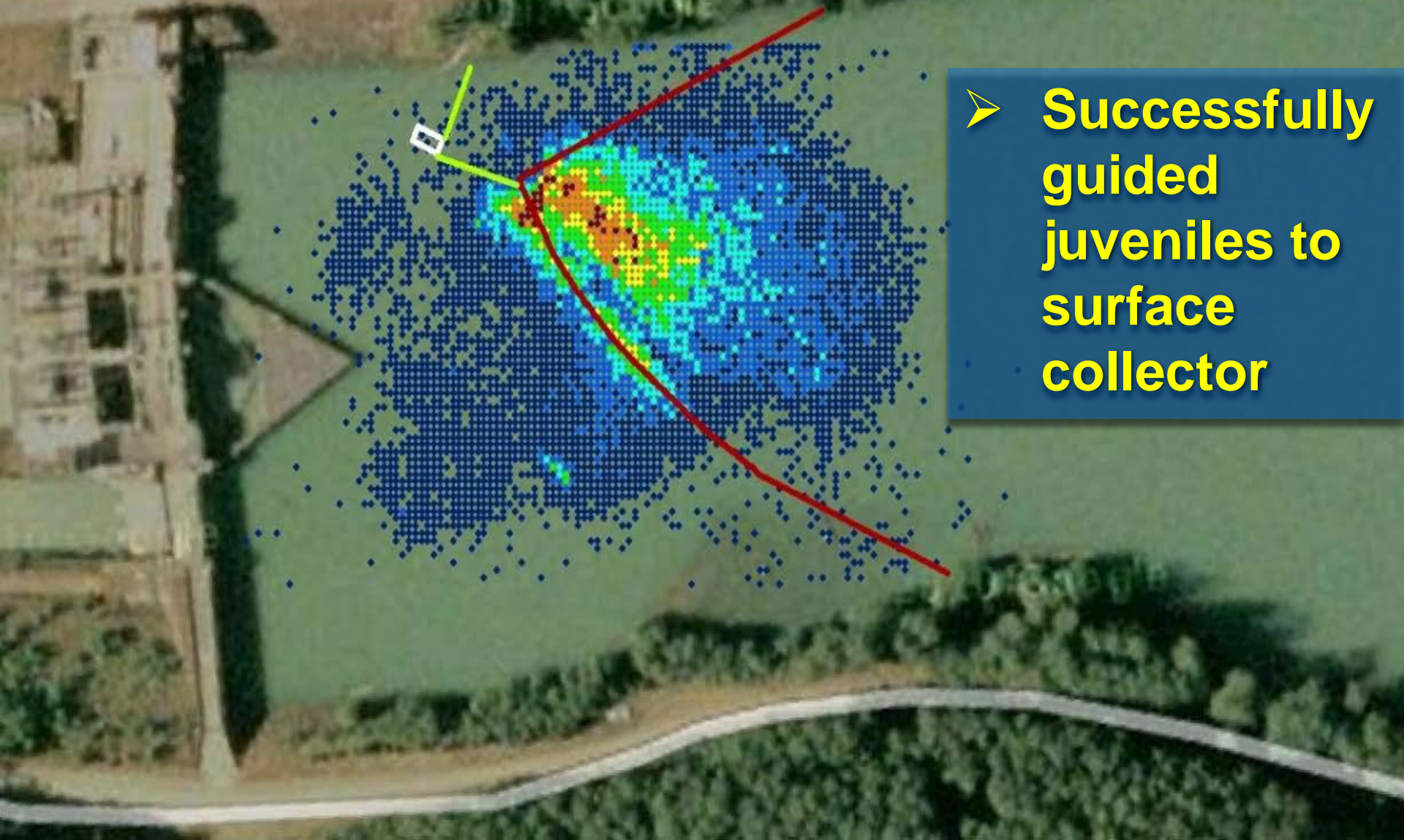
# Cowlitz Falls Dam, Cowlitz River, WA





# Cowlitz Falls Dam, Cowlitz River, WA

## Frequency Distribution of Juvenile Salmonids



➤ Successfully guided juveniles to surface collector



# Lockwood Station, Kennebec River, ME



**FGS**

**Powerhouse**

Lockwood Station



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Image USDA Farm Service Agency

Google earth



# Lockwood Station, Kennebec River, ME



➤ 75+% guidance to safe bypass





# Weston Station, Kennebec River, ME

Weston Dam, Skowhegan, ME 04976  
Skowhegan



Sluiceway

FGS

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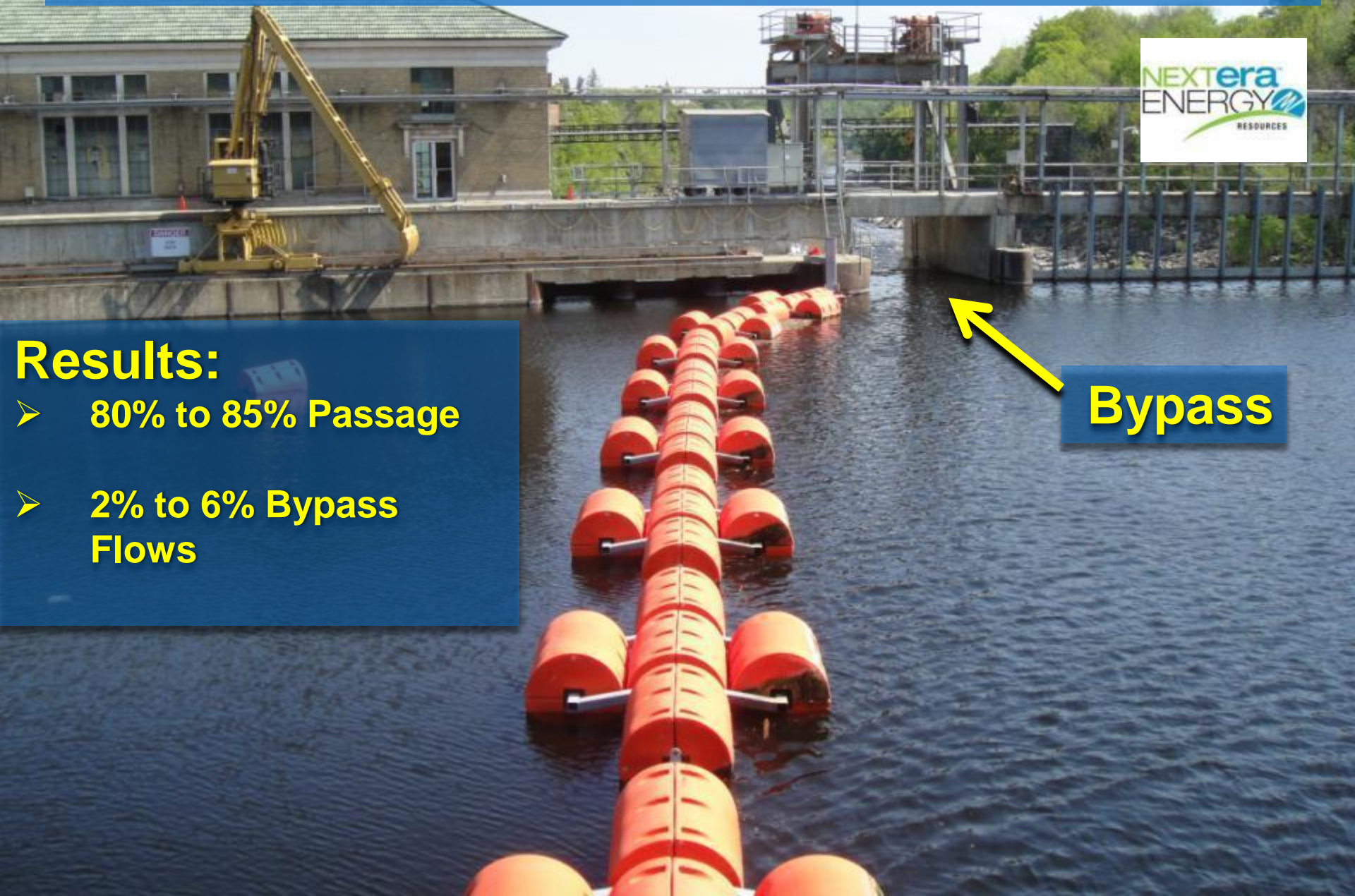
# Weston Station, Kennebec River, ME



## Results:

- 80% to 85% Passage
- 2% to 6% Bypass Flows

**Bypass**





# Kennebec Dam, Kennebec River, ME





# Kennebec Dam, Kennebec River, ME



**Bypass  
300 cfs**

**Results:**

➤ **80% Passage**



# Gilman Dam, Connecticut River, NH



Image USDA Farm Service Agency

Google earth



# Gilman Dam, Connecticut River, NH



**Bypass**



# **Summary**

- **Significantly Improves Juvenile Fish Guidance and Survival**
- **Permanent Physical Structure**
- **Flexible Configuration to Allow Improvements**
- **Can Reduce Operations Costs**

# **Recommendations**

- **Know Site Specific Conditions**
- **Provide Adequate Bypass**
- **Address Debris**
- **Work With Manufacturer**
- **Be Flexible – Modifications Will Further Improve FGS Performance**



# Thank You

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Brookfield



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of Engineers®**

# Fish Guidance System



QUESTIONS?

